The Influence on Children of the Purpose of Experiencing Reading Vocabulary: Encoding-Retrieval Interactions in Word Perception

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Abstract

This research looked at conditions which result in the development of integrated letter code information in the acquisition of reading vocabulary. Thirty grade three children of normal reading ability acquired new reading words in a Meaning Assigned task and a Letter Comparison task, and worked to increase skill for known reading words in a Copy task. The children were then assessed on their ability to identify the letters in these words. During the test each stimulus word for each child was exposed for 100 msec., after which each child reported as many of his or her letters as he or she could. Familiar words, new words, and a single letter identification task served as within subject controls. Following this, subjects were assessed for word meaning recall of the Meaning Assigned words and word reading times for words in all conditions. The results supported an episodic model of word recognition in which the overlap between the processing operations employed in encoding a word and those required when decoding it affected decoding performance. In particular, the Meaning Assigned and Copy tasks appeared to facilitate letter code accessibility and integration in new and familiar words respectively. Performance in the Letter Comparison task, on the other hand, suggested that subjects can process the elements of a new word without integrating them into its lexical structure. It was concluded that these results favour an episodic model of word recognition.

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Chapter One

This study, "The Influence on Children of the Purpose of Experiencing Reading Vocabulary: Encoding-Retrieval Interactions in Word Perception," examined conditions which result in the development of letter code information in the acquisition of reading vocabulary. The information in this study may, perhaps, be useful for assessing to what degree an individual's ability to read a word is based on high quality integrated letter code information.

This study followed procedures of experiments by Whittlesea and Cantwell, who, in "Enduring Influence of the Purpose of Experiences: Encoding-Retrieval Interactions in Word and Pseudoword Perception" (1987), varied the purpose for which adult subjects experienced pseudowords before doing a perceptual test. In their study, Whittlesea and Cantwell discovered that the purpose for experiencing a pseudoword had a lasting influence on the correctness of identification of it, apparently mediated, they wrote, by differential organizations of the parts of the item. The present study in this paper basically replicated the Whittlesea and Cantwell study, except that instead of teaching adults pseudowords, children were exposed to real words. The present study examined the question of whether or not the visual code for a word is stable across different contexts or if it is dependent on the conditions of encoding the word as well as on its nominal identity.

The independent variable was the condition under which the reading vocabulary words were exposed to the subjects. Words were presented in five conditions. New reading words were presented in Meaning Assigned (M.A.), Letter Comparison (L.C.), and New Word (N.W.) conditions; recognized reading words were presented in Copy (C.) and Familiar Word (F.W.) conditions. The dependent variables were the perception of letters in the words, the integration of the letters in the words, and the time it took subjects to read the words in the different conditions.

As previously stated, this study was derived from the research report of Whittlesea and Cantwell (1987) who studied adult subjects' perception of the letters of pseudowords as a result of differential exposures. They found that the purpose for encountering pseudowords had a lasting influence upon the subjects' perception of the pseudowords. Whittlesea and Cantwell (1987) concluded that what was true for pseuodowords could be generalized to include words because unknown words could be equated with pseudowords for the individuals involved. For this present study, however, the words chosen for each subject were not pseudowords. They were "real" words, which were part of each subject's oral vocabulary. Real words were used to assess whether they would behave as pseudowords in terms of the treatments employed.

The present study asked if, for children, the letter codes within a word stay constant or if they change as a function of the context in which they are exposed, and which ways of approaching new reading words, if any, optimize visual learning for children. The information in this study is important for educators to know because it may affect present knowledge of the way children learn to read words. If the way in which a word is encoded by a child affects the identification of the letters in the word or the identification of the word itself, it is important that educators realize this. The knowledge of which ways of acquiring reading vocabulary result in the best letter and word identification should affect the way educators approach the teaching of words.

Although the present study produced worthwhile information about the perception and integration of letters in words by fairly average children when reading, in the future, comparison of the results of this study to the results of poor readers engaged in the same experimental tasks might be useful in the development of measures of visual feature learning and of visual feature integration. In addition, the results of this study can be compared to the Whittlesea and Cantwell study (1987) to further examine differences in adults' and children's perception of words.

Outline of the Thesis

The present experiment involving pretesting, training, and testing basically followed Whittlesea's and Cantwell's procedures (1987). Thirty grade three students were the subjects. The pretests consisted of assessing the ability of each subject to read the stimulus words and to explain the meaning of the stimulus words when they were presented orally. Words which could not be read but which had familiar meanings were used in a New Word control condition, a Meaning Assigned word condition, and a Letter Comparison word condition. For the Meaning Assigned word condition, each subject was exposed on an Apple IIe computer to each Meaning condition word five times in an expanding series. For the Letter Comparison condition, each word was exposed also on the Apple IIe computer five times in an order yoked to the expanding series of the words in the Meaning Assigned condition. Words which could be read and with familiar meanings were used for a Familiar Word control condition and a Copy word condition. For the Copy condition, words were copied by the subject from the computer screen five times in an order yoked to the other training conditions.

Each subject's ability to identify the stimuli after brief presentations was tested after a four hour delay. Then each subject was asked to read these words as they were presented in lists structured on the basis of the original treatment conditions.

Definition of Terms

In this experiment the term word referred to a word that was not only in the dictionary but was also part of the subject's oral vocabulary. New Words (N.W.) were words that were part of the child's oral vocabulary but which the child could not read. Meaning Assigned words (M.A.) were New Words (N.W.) that were assigned a short meaning to be learned as a task and Letter Comparison words (L.C.) were New Words (N.W.) that were used in a letter by letter comparison task. Familiar Words (F.W.) were words which were part of the child's oral vocabulary and which the child could read. Copy words (C.) were Familiar Words (F.W.) which the subject copied.

Assumptions

The main assumption of this study, and, indeed the Whittlesea and Cantwell study (1987), was that letter code information plays a necessary, albeit not sufficient, role in word recognition. Although not popular recently with educators, this assumption is well grounded in the research of Jackson and McClelland (1979). Jackson and McClelland (1979) showed that letter recognition latency is one of the main predictors of (poor) reading achievement.

Statement of the Hypothesis

The Whittlesea and Cantwell study (1987), demonstrated that the learning of pseudowords by adults is dependent upon the purposes for which the pseudowords are experienced by the subjects. It demonstrated that not only does the purpose for learning the pseudowords affect the degree of learning, it actually affects the extent of integration of the letters in pseudowords. The present study hypothesized that manipulating the purpose for which children encounter real words prior to a perceptual test influences the accuracy of identification of the words.

Specifically, Whittlesea and Cantwell argued that the demands of the task when processing a string of letters result in variations of the integration of the letters in the string (Cantwell, 1985). They pointed out that a task requiring integrative processing of an item results in a great deal of integration of the component parts of the item, whereas a task requiring more independent processing of the components results in much less integration of the component parts. A Concordance Index was performed (Whittlesea and Cantwell, 1987) to measure the perception of each letter in a string dependant upon the perception of each other letter in the string. In this study some new reading vocabulary words were processed by children in an integrative fashion by learning the definitions of new reading vocabulary words, and some were processed in a way in which the components of the words were processed much more independently by having the children perform a letter by letter comparison task of the letters in the words. The integration of the letters in each group of words was measured and was compared to that of other new but untrained reading vocabulary words. Similar to Whittlesea's and

Cantwell's study (1987), this study hypothesized that, for a child exposed to new reading vocabulary, the amount of integration of the letters in a word is a function of the demands of the task.

In the third experiment of the Whittlesea and Cantwell paper (1987), words were perceived equally to pseudowords learned with meaning. Then, in the fourth experiment of the Whittlesea and Cantwell study (1987), an attempt was made to look at the effect of episodic encoding on words which were familiar and part of the subject's reading vocabulary. The results showed that encoding words in the context of the experiment affected the subject's perception of the words. Specifically, it was observed that the encoding task employed had a significant effect on perception and integration of letters in words relative to words not worked with in the experiment. It seemed noteworthy that perception and integration of words significantly improved by performing a simple Copy task. Therefore, the Copy task from the Whittlesea and Cantwell paper (1987), was repeated with children. It was hypothesized in this study that processing familiar reading vocabulary words would improve a child's perception of the letters in them and the identification of the words themselves. It was also hypothesized that the task of copying familiar reading words would result in greater within-word letter integration.

In the Whittlesea and Cantwell study (1987), the Word Superiority Effect (Reicher, 1969) was verified for adults.

In the first two Whittlesea and Cantwell experiments (1987) perception of single letters in words was compared to single letters in isolation. The results supported the W.S.E. In the third and forth experiments of the Whittlesea and Cantwell paper (1987), the perception of all letters of words was compared to the perception of isolated letters amongst pattern masks. A correct word unit scored equally to a correct single letter and pattern mask unit. In all four experiments of the Whittlesea and Cantwell paper, letters in words scored higher than letters in isolation. It was hypothesized that, for children, as well as for the adults in the Whittlesea and Cantwell experiments, the letters perceived in the words would score higher than the single letters with pattern masks.

Chapter Two

A Review of the Literature

The Importance of Letter Codes in Word Recognition

There are two opposing views about the importance of letter codes in word recognition. One view argues that reading is a psycho-linguistic guessing game in which the use of context when reading negates the need to process letter code information in detail (Smith, 1971, 1975; Goodman, 1974, 1977, 1979). For beginning readers, it has been argued that attention to meaning is the most important focus. Goodman encouraged beginning readers to concentrate on meaning and encouraged prediction as a main strategy for beginning reading (1974, 1977, 1979).

The opposing view argues that differences in reading ability are accounted for by letter identification or matching performance (LaBerge and Samuels, 1974; Gibson, 1971; Jackson and McClelland, 1979; and McClelland and Rumelhart, 1981; Rumelhart and McLelland, 1982). LaBerge and Samuels (1974), like Gibson (1971), insisted on the primary importance of letter codes for beginning reading. In a bottom up model of word learning, LaBerge and Samuels (1974) portrayed the process of reading as a progression of stages of learning built on the bottom level of features to letters. According to their model, learning progresses from features to letters, to patterns of spelling, to perceiving words semantically, and then perceiving the meaning of groups of words. While stages may possibly be missed, a higher stage of learning cannot, by their model, influence a lower stage and, therefore, letter learning is an early step to beginning reading and does not come after learning the whole word. Jackson and McClelland (1979) showed that letter recognition latency is one of the main predictors of (poor) reading achievement. They argued that "one skill allowing for fast readers to capture more information from each reading fixation is faster access to letter codes from print" (p. 151). McClelland and Rumelhart (1981) designed a full model of the role of letter code information in word recognition which supports this second view. They called it the Interactive Activation Model. They contended that information passes from one level of processing to the next (the feature level, the letter level, the word level) and that each of these levels is made up of enough nodes to accommodate all possible items that could be present at that level. If nodes are consistent they are excitatory and aid connections; if nodes are inconsistent they inhibit perception. Visual features activate letters which are consistent. The visual perception of letters grows stronger and activates consistent words that correspond to the letters, with the active word detectors then working the opposite direction to reinforce the letters in the words.

In "An Interactive Activation Model of Context Effects in Letter Perception: Part 2" (1982), Rumelhart and

McClelland then examined and elaborated on their Interactive Activation Model. Although they found that sometimes their intuition about how the model would work was wrong, their model gave a good account of the perception and pronunciation of real words and as well of pseudowords. They argued that their data supported a model in which, "through the use of interactive processes, the mere activation of stored representations of familiar patterns can suffice, at least to account for the perception of letters in novel pseudowords" (p. 93). They also suggested that "it may be fruitful to continue exploring the possibility that other types of apparently rule governed behavior may be accounted for by synthesis of stored knowledge about individual cases" (p. 93).

The Integration of Letter Codes with Word Codes During Word Recognition Learning

Advocates of interactive theories of word recognition (Rumelhart and McClelland, 1982) regard efficient bottom up data driven processing as essential to fluent reading. However, there appears to be a problem arising from the emphasis that is placed on letter codes (Jackson and McClelland, 1979) and their integration with higher order word codes (McClelland and Rumelhart, 1981). This is because most theories of learning to read that require the acquisition of letter code information in the learning of new reading words (Ehri and Wilce, 1983; Gough, 1972; Gibson and Levin, 1975; LaBerge and Samuels, 1974) appear to favour discrimination learning models which emphasize the process(es) of differentiation, with these models seldom specifying, how the process of differentiating a letter in a word is related to the process of integrating it with the word's orthographic, phonemic, or semantic codes. It is usually assumed that differentiation precedes or at least begins before integration but very little is said about how these two types of processing interact. In this respect, the possibility that some learning activities may facilitate one type of processing at the expense of the other is seldom considered.

It is not unreasonable to hypothesize that there may be activities which promote the differentiation of letters in words but not their integration. Smith (1971, 1973), for example, has hypothesized that traditional phonics instruction may encourage the child to process new reading words in a manner that is different from the processing required when they are being read in a passage or story context with some letter-sound associations presented as inter-word linguistic units which have a reality independent of the words in which they occur. Whether or not one believes this to be true, this approach may encourage the child to differentiate and encode these units in a way that is less integrated with the host or exemplar words than might otherwise be the case. Thus, at the time of recognition, there might be a tendency for the child to retrieve a particular letter-sound association without retrieving the host word.

Current models of word recognition have been based on the argument that perception is a function of abstracted, stable, representations such as logogens (Morton, 1969, 1979) or orthographic and phonemic generalizations (Gibson and Levin, 1975). Although sentence context and other linguistic units can prime word recognition, such effects are viewed as temporary and the result of processing which is either pre or postperceptual in nature (Jacoby, 1983). Within this framework, the learning of new words is conceptualized as the gradual development of schemas which preserve only those properties which do not change across recognition instances (LaBerge and Samuels, 1974; McClelland and Rumelhart, 1981).

The purpose of this research was to test an alternative point of view to the current models of word recognition. Kintch (1974), Jacoby and Brooks (1984), Brooks (1987), and Whittlesea and Brooks (1988), have proposed an instance based model of word recognition in which perception is a function of processing episodes which preserve individuating and contextual information. Within the framework of this model, each encounter with a word is stored as a separate record and all records are activated in parallel during recognition. The degree of activation of a given record is determined by its similarity to the encoding of the to-be-recognized word. The record(s) which is most similar to this encoding is matched to it in a pattern completion operation and recruited in generating a response (Kintsch, 1974). Similarity is determined by the overlap between the encoding operations employed during the initial encounter with the word and the subsequent recognition task. Thus, if the initial encoding of a word is in terms of its phonemic features and subsequent recognition involves the encoding of its visual features, similarity will be reduced. Alternatively, if both encounters involve the encoding of the same contextual details, similarity will be increased. Implied is the argument that no stimulus domain or single way of encoding is privileged. What matters is the overlap between processing events.

In the paper upon which this study was based, Whittlesea and Cantwell (1987) looked at associating meaning with a pseudoword as a process and found that the process of learning the pseudoword with its assigned meaning improved the later recognition of the pseudoword. In their study (1987), they varied the purpose for which university adults experienced pseudowords before doing a perceptual test and discovered that the purpose for experiencing a pseudoword had a lasting influence on the correctness of identification of it, apparently mediated, they wrote, by differential organizations of the parts (letters) of the item.

In Experiment One of the Whittlesea and Cantwell paper, a set of twenty-four orthographically legal, pronounceable, CVCVC non-words was created. Twelve were given short definitions which thirty subjects learned with the words (Meaning condition) and twelve were not introduced to the subjects until the test (Novel condition). The testing consisted of identifying target letters in the stimuli that were presented on a computer screen for 20 msec. The stimuli were pseudowords in the Meaning condition and the Novel condition, twelve high-frequency CVCVC natural words and twelve single letters in isolation. Letters in Meaning condition pseudowords and those in words were not perceived significantly differently to each other, but were perceived significantly better than those in Novel pseudowords. They were also perceived better than letters in isolation.

A second experiment was performed to see if letters in other conditions would be perceived as well as Meaning Assigned condition pseudowords. On the computer screen, the letters in the Novel pseudowords were compared by the subjects with those of a letter string below. The testing exposed groups of five letters and the single letters on the computer screen for 30 msec. The perception results were that words and Meaning Assigned pseudowords were perceived significantly better than Visual Comparison pseudowords and single letters.

Experiment Three required the reporting of entire stimuli by the subjects so that the integration of the letters in the stimuli of the different conditions of the experiment could be measured as well as could the perception of the letters. The stimuli were on the computer screen for

20 msec. each for the testing, and the testing took place 24 hours after performing the training tasks to see if the results were lasting. It was discovered that the letters of the Meaning Assigned pseudowords were integrated more than the letters of the Letter Comparison pseudowords. It was also found that performance in the Meaning Assigned condition was independent of the ability of the subjects to retrieve the assigned meanings when shown the pseudowords in a post test. This was interpreted as evidence that the Meaning Assigned task affected encoding as opposed to retrieval operations. It was also discovered that the scores for the integration of the letters in the different conditions were of a similar pattern to those for the perception of letters except that words were more integrated than pseuodwords.

Experiment Four of the Whittlesea and Cantwell experiments exposed the words in the context of the experiment. Whittlesea and Cantwell found that words presented in the context of the experiment by copying them, were perceived better than Meaning pseudowords. Whittlesea and Cantwell wrote that when "familiarity in context is held constant, perceptual dependence predicts perceptual accuracy of both pseudowords and words" (p. 22). Also, although the task of reporting all letters was not a traditional W.S.E. task, the results were consistent with those in the first experiments of the Whittlesea and Cantwell study (1987) with the letters in words perceived better than those in novel pseudowords and single letters.

The findings of Whittlesea and Cantwell (1987) should be viewed in the light of the results of a second study by Whittlesea and Brooks (1988) in which it was shown that superior letter perceptibility was a function of the interaction between encoding and retrieval contexts. Whittlesea and Brooks (1988) observed that letters were perceived better in words than in isolation when they were initially encoded in words, and letters were perceived better in isolation than in words when they were initially encoded in isolation. Thus, the reinstatement of the encoding context (which can be blank screen or page) at the time of test was a critical factor in letter identification accuracy. This, too, suggests that it was not meaning per se which resulted in superior letter perception in Whittlesea's and Cantwell's (1987) study, but rather the overlap between the processing operations required in the meaning assigned task and the processing operations required when the pseudowords were exposed at test. This overlap was not complete but it was clearly greater than that achieved with the letter comparison task.

Integration of letter codes with word codes is shown to exist in Word Superiority Effect studies. Reicher (1969) defined the Word Superiority Effect (W.S.E.) as subjects being more likely to recognize letters in words than letters in unrelated letter strings. He found that there was a Word

Superiority Effect (W.S.E.) and that it was not the result of a subject's knowledge of words allowing a subject to guess appropriately what letters were in words as opposed to letter strings. Wheeler (1970) then found that frequency of the word's use did not cause greater perceptibility of the letters in a word. Also, Wheeler found that individuals perceive letters better in words than singly. He contended that this is because individuals are more used to seeing letters in words than in isolation. Baron and Thurston (1973) found that letters in non-words that were pronounceable were perceived better than letters found singly and in words which were difficult to pronounce, which suggested that the meaning associated with a string of letters does not cause the W.S.E. Baron and Thurston then observed that there was no significant difference in perceiving homophones or words that do not sound alike, indicating that pronunciation distinctions do not affect W.S.E. They consequently proposed that the orthographic structure of words must cause the W.S.E. McClelland and Rumelhart (1981) argued that until Reicher's (1969) findings, it was possible to "imagine that the context in which a letter was presented influences only the accuracy of post perceptual processes and not the process of perception itself" (p. 376), but that it was subsequently evident that "knowledge about words can influence the process of perception" (p. 376). McClelland and Rumelhart (1981) devised a model based on this information. In it, a process of activating detectors is begun with visual features activating letters with these active word detectors then reinforcing the letters in the words. McClelland and Rumelhart wrote that "letters in words are more perceptible, because they receive more activation than representations of either single letters or letters in an unrelated context" (p. 376). This additional activation comes from top-down orthographic, morphemic, and word level feedback loops.

Fietelson and Razel (1984) looked at the idea that sometimes words are identified more easily than letters, probably because of shape. In their study, Feitelson and Razel worked with Israeli kindergarten children and found that these children could identify single letters more easily than whole words, refuting a notion, at least for young children, that because of word shape, words sometimes are perceived more easily than single letters. This suggests that the relationship between letter perception and word perception might be different for older and/or fluent readers. It may be, for example, that letter codes are less integrated with phonemic, and semantic codes of words in the young and/or beginning reader. This would suggest that letters which are identified in words may not benefit from feedback activation (Rumelhart and McClelland, 1982) for the beginning reader in the way they do for the fluent reader. As a consequence, the word superiority might not be observed or might show up to a lesser degree in beginning readers.

Actually, kindergarten children did show no extra skill at letter identification in words to non-words (Juola, Schadler, Chabot, and McCaughey, 1978). However, just before grade two, children demonstrated the W.S.E. McCaughey, Juola, Schadler, and Ward (1980), discovered that pre-grade two children could find target letters in words faster than in pseudowords and in non-words. Adults found the target letters about equally in words and pseudo-words, but more slowly in non-words. McCaughey et al. concluded that the difference between the target letter identification results of pre-second grade children and adults was due to pre-grade two children's inability to recognize and use the regularities of standard English orthography in pseudo-words, whereas adults did use this orthographic information to find target letters in pseudo-words. Second and fourth grade children performed similarly to adults except for speed at finding target letters in words, pseudo-words, and non-words (McCaughey et al., 1980). This indicates a progression toward orthographic skill as children progress through the primary school years.

The studies of Juola et al. (1978) and McCaughey et al. (1980) did not, however, examine children's perception of letters in isolation to children's perception of letters in words. Whittlesea and Cantwell (1987) found that adults perceived letters in words significantly better than as isolated letters. In Experiments One and Two of their paper (1987), a fairly traditional W.S.E. study was performed and expected results were found. However, in Experiments Three and Four of their paper (1987), their W.S.E. test was untraditional because all letters in the words were reported. However, the results were again consistent with the W.S.E. literature. It was decided to compare children's perception of single letters amongst pattern masks to letters in words, as the Whittlesea and Cantwell Experiments Three and Four had done with adults.

Summary

This review of the literature suggests that, for word learning, a semantic orientation was often found to produce superior recognition (Smith, 1971, 1976). Baron and Thurston's 1973 study demonstrated how letters in pronounceable non-words are perceived better than letters in difficult to pronounce words. Jackson and McClelland (1979), in their study, emphasized the importance for word recognition of efficient letter code processing. The study of McCaughey et al. (1980) demonstrated how age can affect orthographic skill. Jacoby and Brooks wrote about non-analytic cogitation where "Memory for episodes contributes to perceptual identification of the...item" (1984, p. 72). The literature, therefore, suggests that there are influences other than the pure influence of semantic orientation that may promote superior performance in recognition or reading of words.

Jacoby and Brooks (1984) stressed the importance of non-analytic judgements. They also stressed the importance of episodic memory and task demands in encoding-retrieval interactions. Whittlesea and Cantwell (1987) also found that task demands are very relevant to learning.

It was decided to ascertain the effect of tasks at the time of encoding on learning results at the time of retrieval for children experiencing new and familiar reading vocabulary. As mentioned, Whittlesea and Cantwell (1987) found that meaning was very important to increased learning of pseudowords. However, they concluded that it was not meaning but the experience or process of learning meaning that caused the greater perception of Meaning Assigned words over words experienced in a Letter Comparison task.

The study in this paper will be based on and follow fairly closely the procedures used in the experiments with adults perceiving pseudowords in the Whittlesea and Cantwell study (1987). However, this study will have a single experiment rather than a series of experiments and, rather than adults and pseudowords, will examine children learning reading words. While pseudowords may behave as actual words, it is important for educators to know if the results of the Whittlesea and Cantwell study are, in fact, the same with individuals experiencing words. It is important to know if children perceive and integrate letters in the way that adults do, and it is obviously important for educators to know which of the ways of approaching new reading vocabulary words with children optimize visual word learning for children.

Reading instruction may take the form of teaching reading through the writing of words. Write to read programmes encourage a great deal of writing of material such as stories and journals to develop a student's knowledge of the ingredients of written words for the benefit of the student's reading skill. Reading instruction sometimes treats word and letter learning as an integrated process. In Language Experience programmes, a student's own words are printed as complete units. In the Whole Word method, words are taught directly by associating the words with their meanings without reference to the alphabet. Also, reading instruction may focus a reader's attention on individual letters of words. The ABC Method, which is not popular today in schools, teaches children the letter names. Then simple syllables, some of them being words, are learned and spelled out using the letter names. Phonics programmes require the sounding out and then blending of the letter sounds of words. Although good phonics programmes encourage integration of the letters through blending sounds, poor phonics instruction may not encourage the blending of sounds in words and, therefore, may cause the letters of words to be learned in a fairly segregated fashion. Blending may not be stressed or, more likely, the teaching of the letter sounds may be in ways that make it difficult to use the letter sounds for blending. Crowder wrote, "Try to speak the segment {p} by itself. You will probably have pronounced a syllable spelled approximately Puh. This Puh is not an isolated phoneme. It is a two-segment syllable" (1982, p. 225). Good phonics instruction would teach a student to integrate the {p} with the letter that follows by not incorporating the sound "uh" with the {p}, but instead, by producing a crisp airy sound preceding the vowel sound of the next letter. If the integrating process of the letter sounds is achieved, a word will be learned as a fairly integrated unit, as proponents of phonics programmes advocate. However, if this skillful blending is not achieved by a student, a segregated sounding out of the letters of words could easily be the result. It would be interesting to study the results of experiencing words through tasks that approach the letters in words in a segregated way and through tasks that approach the letters in words in an integrated fashion. The perception of letters, integration of letters, and speed of reading words taught in a task that encourages integration of the letters in words (Meaning Assigned task) and in a task that discourages the integration of letters in words (Letter Comparison task) will be examined. Also investigated will be the perception of letters, integration of letters, and speed of reading recognized words in a writing task (Copy task). The perception of letters in words as opposed to those in isolation will also be noted and assessed. These tasks are not identical tasks to those mentioned when discussing reading instruction methods. However, the results should be interesting and relevant to educators concerned about the teaching of reading vocabulary. They should provide important information about the effect on reading skill of performing tasks that encourage letter integration and segregation. Interesting results were found in a similar study by Whittlesea and Cantwell (1987).

The experiment in this paper will attempt to replicate fairly closely the Whittlesea and Cantwell experiments (1987). Differences will be that children are to be the subjects rather than adults, and words will be used rather than pseudowords. One experiment will replace the four Whittlesea and Cantwell experiments, with concentration on the fourth experiment of the Whittlesea and Cantwell paper (1987). Also, a list reading test of the words in the different conditions will be added to measure speed of reading the words learned in the different conditions.

The following hypotheses state the expected results for these proposed investigations into the learning of reading vocabulary by children. The hypotheses are based on the findings of the Whittlesea and Cantwell study (1987) of adults learning pseudo-words.

Hypothesis I: The purpose for which a child encounters new reading words prior to a perceptual test will influence the child's ability to perceive the letters in these words.

Hypothesis II: The amount of perceptual integration of the letters in new reading words is a function of the tasks employed in acquiring the words.

Hypothesis III: Copying familiar reading words affects the perception of the letters of these words.

Hypothesis IV: Requiring the copying of words by a child that he or she already recognizes visually, causes greater letter integration in those words.

Hypothesis V: The perception of letters in familiar reading words will be superior to the perception of letters in isolation.

Chapter Three

Research Methodology and Design

Introduction

The Whittlesea and Cantwell experiments (1987) found that the purpose for experiencing pseudowords influences adults' perception and integration of the letters in pseudowords. An attempt was made to replicate fairly closely the Whittlesea and Cantwell experiments (1987) except that children were the subjects and words were the stimuli. It was decided to use one experiment basically combining the four Whittlesea and Cantwell experiments but concentrating on their fourth experiment. Also, a decision was made to add a post-test to time the reading of the words blocked in the different conditions of the experiment.

The pseudowords in the Whittlesea and Cantwell experiments (1987) were replaced with new reading words for each of the children involved. These were used for a Letter Comparison task (L.C.) and a Meaning Assigned task (M.A.) as well as a control group (N.W.). Words in the Whittlesea and Cantwell experiments were replaced with familiar reading words (F.W.) for each child in the experiment. These familiar reading words were used for a control group of familiar words and a Copy Task (C.).

In the third experiment of the Whittlesea and Cantwell paper (1987), words were not perceived better than pseudowords learned with meanings. In the fourth experiment of their paper, the copy condition was included to determine if words would be perceived better than pseudowords learned with meaning if the words were also worked with in the context of the experiment. The result was increased learning of the words (greater integration and perception of the letters). This result seemed quite remarkable since the words were already learned and the copying task was so simple. It, therefore, seemed very worthwhile to repeat the Copy task with children to see if skill at reading familiar words could be improved for them as well.

It was decided to do a variation of a Word Superiority Effect study (Wheeler, 1970) by comparing the perception of isolated letters with letters in the words. Whittlesea and Cantwell (1987) compared perception of isolated letters with target letters in pseudowords in Experiments One and Two and with all letters in pseudowords and words in Experiments Three and Four of their study (1987). Their results were consistent with Wheeler's findings (1970) that letters in words are perceived better than isolated letters.

Expectations were that the results of the Whittlesea and Cantwell study (1987) would be fairly closely replicated in this study. Based on the results of the Whittlesea and Cantwell study (1987), the hypotheses are as follows:

Hypothesis I: The purpose for which a child encounters new reading words prior to a perceptual test influences the child's ability to perceive the letters in the words.

Hypothesis II: For a child, the amount of perceptual integration of the letters in a new reading word is a function of the tasks employed in acquiring the word.

Hypothesis III: For the child, the copying of familiar reading words affects the perception of the letters of the words.

Hypothesis IV: Requiring the copying of words by a child that he or she already recognized visually, causes greater letter integration in the words.

Hypothesis V: The perception of letters in words will be superior to the perception of isolated letters.

A one factor within subject design was used. There were six levels of the factor. These were the Conditions of Presentation of the words: M.A. (meaning assigned), L.C. (letter comparison), and N.W. (new word) for new reading words; F.W. (familiar word) and C. (copy) for known reading words, and S.L. (single letter).

The Experiment consisted of three phases: a pre-test phase, a training phase, and a test phase. The pre-test phase involved determining groups of words for each child that would be employed as stimuli in the training and transfer phases. Approximately two weeks later, the training phase was performed. In the training phase, each child performed three tasks: M.A. task, and L.C. task using new reading words, and C. task using known reading words. Words determined in the pretesting phase were presented in each of the tasks. For each task a different set of words was presented. The M.A. task required the child to learn the definitions of ten new reading words. In the L.C. task, the child compared the letters of ten new reading words with pseudowords. The C. task required the child to write ten known reading words on a piece of paper. The test phase was conducted four hours after the training phase and in this phase, a perceptual identification task was performed. This task required the child to identify words that were flashed briefly on a computer screen. The list of words determined in the pre-testing phase was presented in the perceptual identification task. The perception of letters, integration of letters, and speed of reading were the dependent variables.

Subjects

The subjects in this experiment were assessed as being fairly average (as defined by their teachers) primary children. They were thirty English speaking eight-and-nine year-old Grade Three boys and girls from a public elementary school in a suburban town in Southern Ontario. Permission was received to do the experiment both from the superintendent of the Board of Education and the school staff involved. Also, parental approval was sought, with one child's parents denying permission for their son's participation. Children from the classes involved were selected by their teachers as seeming not to be exceptional in any way (intellectual, emotional, cultural, social, psychological, or by age). Since the children were doing all of the experiment and their results were compared against their own results and not those of the others, this selection of the subjects seemed appropriate.

Children considered to be average were used because it is important for educators to know what affects the acquisition of reading skill for normal children before they can assess the needs of children with problems. Primary children were chosen because they are at a beginning stage of reading and are, therefore, at a very important point in reading development. Also, the reading ability of primary children is such that many unrecognized reading vocabulary words could be found for use in the experiment. Grade Three children were chosen because, being the most advanced of the primary children, they were most likely to have enough reading experience to participate in the experiment and they were old enough to be able to enjoy such an experiment.

Materials, Instrumentation and Data Collection

For this experiment, an Apple IIe computer and a Zenith monitor were rented. Response keys were attached to the computer to allow the subjects to control the time of the appearance of the stimuli on the monitor.

There were four types of stimuli used in this experiment: recognized words, new reading words, pseudowords, and single letters. Single letters and one group of unrecognized and one group of recognized words were not used in the training sessions. All stimuli were made up of capital letters on the computer.

In the test phase, the perception of letters, recognized or guessed by the subjects from the computer, was stated by each subject and printed for him or her onto a paper by the experimenter. Each subject's knowledge of the meaning of the Meaning Assigned words was then noted. Also recorded was the timing on a stop watch of the reading of each condition of words.

Procedures

Subjects participated individually in a quiet room. For the pre-test, the subject sat at a table beside the experimenter; for the training tasks and test phase, each subject sat beside the experimenter in front of a Zenith monitor with response keys in front of him or her. The experiment was divided into three phases: pre-testing, training and testing.

Pre-testing. Subjects were pre-tested to determine lists of words to be used in the training and test phases. Five letter concrete words were used and the pre-test determined if these words were recognized in print.

Pre-testing began with the first word in a master list of words and progressed down the list until enough complexly and simply spelled words were acquired for each subject involved. Complexly and simply spelled words were used because this gave a balance of reading words and because it was difficult to acquire for each child thirty simply spelled reading words that were not recognized in print but were part of the child's oral vocabulary. Complexly spelled words for this experiment were words judged to be less phonemically simple than the others. For example, rough, wharf, and eight were judged to be more phonemically difficult than human, boost, and canal. The words isolated and printed in lower case letters on a paper were shown to the subject one at a time and the child was required to attempt to read the word out loud.

Pre-testing also determined if these words were "real" to the child. The same words, one at a time, were pronounced but not shown to the child, and the child was required to give each a definition. If the word had some accuracy of meaning for the child it was deemed "real" to him or her. The master list of all possible words used for the conditions of the experiment is in the Appendix.

<u>Preparation of the training exercises.</u> Five subsets of ten words were created: three from the New Word group and two from the Familiar Word group. A master list of words for the pre-test alternated words deemed to be simply and complexly spelled. By using a balance of odd and even

numbered words for each of the conditions, the equalizing of the difficulty of the words in the different conditions was attempted. Each child's sets of words, as well as ten single letters found in each child's stimulus words, made up the sixty item test file.

The three groups of unrecognized words for each subject were used in three ways. They were used for a control group, for a group learned with definitions, and for a visual letter comparison group. The two groups of Recognized words were used for a control condition and for a training condition in which each word was copied by the subject.

Training phase. There were three tasks in the training phase: M.A. (Meaning Assigned), and L.C. (Letter Comparison) for the training of the new reading vocabulary, and C. (Copy) for the training of the known reading vocabulary. The order of executing the tasks was counterbalanced across the subjects. Using a response key attached to the computer, each child controlled the timing of the presentations of the words in all of the training conditions. Practice trials were given for each condition.

Training Exercise for the M.A. condition. Each word and its definition was presented on the computer. For each child, the words to be used for the M.A. condition were given an appropriate, simple, six-word definition (i.e. SWORD - a sharp tool used for fighting). Each word was presented five times in an expanding series (i.e. the word was presented first, second, fifth, seventh, and tenth). The first time a word was presented, the definition also appeared and the word and definition were pointed to and read to the child by the experimenter. The remaining times, only the word appeared on the screen and the child was asked a question about the word (i.e., "Would you use a sword for drawing pictures?"). For the second and fourth times, correct answers were "yes." The third time the correct answer was "no," and the final time, the child was asked to give the definition. After the information was given by the child in each of the second to fifth presentations, the child, at his or her inclination, pressed the response key, causing the definition of the word to appear on the screen under the word making the correctness of each response evident to the child.

Training exercise for the Letter Comparison condition. For each child, the words to be used for the Letter Comparison condition were presented on the computer in an expanding series. For each exposure of a word, a pseudoword was printed underneath. In front of the subject was a paper with two columns titled Same and Different. In each column there was a list of groups of five blanks. The subject's task was to compare a letter in a word with the letter in the pseudoword directly underneath it. However, the whole word remained on the screen as the letters were worked with individually. The student was instructed to print each letter of the word in the correct position appropriate to one of the five blank spaces in either of the two columns, according to whether the corresponding letters in the word on the computer were the same or different to those of the same position letters in the pseudoword on the screen. As in the Meaning Assigned condition, the subject was in control of the length of time that the material was on the screen. The order of the letters in the words being looked at were left to right.

For the Letter Comparison condition, the pseudowords were made as much like real English language words as possible and adhered to the following patterns. The first time each word was visually compared, the invented word had a first, third, and fifth letter that matched a real word (i.e., SWORD for the word and SLOAD for the pseudoword); the second comparison was a visual comparison of the word to a pseudoword with the second and fourth letters matched; the third comparison had the first, third, and fifth again matched; the fourth had the first, third, and fourth matched, and the fifth comparison was made with the second and fifth letters matching the real word.

<u>Training exercise for the Copy condition:</u> For each child, the familiar words to be used in the Copy condition were presented on the computer in an identical expanding series to that of the other training conditions. Each child simply copied each word that appeared, controlling for himself or herself the rate at which the words appeared.

Preparation for the test phase. To prepare each subject for the test phase, a program of ten sets of five numbers was used. Each subject was asked to look at the computer screen and tap the key in front of him or her, which, for 1,000 msec., put five numerals on the screen. The subject was then to try to tell the experimenter what the numerals were. Each subject did this with the ten different groups of numbers. The task was then repeated by the subject with the numbers flashed for 800 msecs., and then a third time the task was performed with the numbers flashed for 150 msecs.

Test phase. A perceptual identification task was next performed by each subject. The stimuli used in this task were the words presented in the M.A., L.C. and C. training tasks, two other groups of words, N.W. and F.W., and also single letters (S.L.). For each subject an activity was comprised, in a mixed order, of all that subject's words from all five conditions as well as the ten single letters. The single letters were taken from the child's words and were placed in one of five spaces in a way that would duplicate a letter's position in at least one of the child's words. The words and letters of this activity for each subject were printed on a disc so that each word or letter could be flashed for 100 msecs. each time the lever was pressed by the subject. For the activity, the subject was told to say the letters so that the experimenter could print the letter or letters onto a sheet with columns of groups of five spaces for letters. The subject was to guess, when necessary, in order to fill in each appropriate space.

Next, the Meaning Assigned words for each child, printed in isolation, were shown. Each child was required to try to give the definitions of the words. Correctness was recorded. The words from all other conditions but the Meaning condition were then read with the subject, with the words from these conditions randomly distributed for the reading. The subject then read each block of words for each condition of the experiment, including those of the M.A. condition, and the reading of these blocks of words was timed on a stop watch. The order in which each condition of words was read was counterbalanced across the subjects.

For the observation of reading speeds of the subjects, the reading of each list of words for the different conditions was always performed in an identical manner for all conditions, including the Meaning Assigned condition.

Data Processing and Analyses

Perception of letters in words. The test was comprised of five item units. The five items of each unit were five letters for the words and four pattern masks and one letter in various positions for the single letters. A five item unit scored zero to five. A one-way analysis of variance was conducted on all conditions to establish if there was a main effect of condition of presentation. Tukey's Test established which were the significant differences, at the

.05 level of significance, of the means of the correctly reported letters in the different conditions for the new reading words and for the known reading words.

Dependency analysis. The relationship between the perceptual identification of a given letter and the remaining letters in a word was investigated. The dependency of recognizing a second letter in the same word was analyzed using a Concordance Index (Whittlesea and Cantwell, 1987). In this procedure the number of hits and misses in each possible pair of letters in a word is calculated. The hit-hits and miss-misses of the four possible combinations of each of the ten letter pairs in a word is then computed across all possible pairs. These computations can be illustrated by considering the ten items used in the M.A. condition. Looking at the first two letters of each stimulus word, four logical outcomes can be identified: a hit on the first letter and a hit on the second; a miss and a miss; a hit and a miss; and a miss and a hit. These outcomes were evaluated for each of the ten items for each of the thirty subjects, resulting in three hundred pairs of data distributed across a four-fold table. The probability of consistent outcomes was then determined by adding the hit-hit and miss-miss probabilities. The five positions in which the letters occurred were selected in ten pairs and the Concordance Index was calculated for each pair. This procedure was repeated for each of the remaining conditions.

Analysis of letter position. The mean scores of the correctly perceived letters in the different conditions of the new reading words (M.A. and V.C. and a control condition) and familiar reading words (C. and a control condition), were noted. In order to determine if the letter position curves would vary because of condition, an Analysis of Position was performed and graphed.

Correlation of perception and meaning recognition. In order to determine whether perception of the letters in the words was dependent upon recognition of the meaning of the words, a Point Biserial r^2 was calculated. A point-biserial r^2 was calculated for the number of letters correctly identified in a M.A. stimulus word and the probability of correctly recalling the meaning or definition of the word.

Reading times. To compare the speed of reading the words in the different conditions, each subject's reading of the words blocked in each condition was timed. The order of the conditions read was rotated for the different subjects. The total reading times for all subjects for each of the conditions was compared.

Chapter Four

Results of the Study

Anova of the Mean Perception Scores

The Anova is on letter identification scores. Letters of the stimulus words in the experimental conditions were given a score of one for correct identification in correct position for a possible total score of five per stimulus unit. Table 1 shows the mean scores of the letters perceived for the familiar and new reading vocabulary conditions.

Table 1

Perceptual Identification of Letters

	Conditions					
	N.W.	M.A.	L.C.	F.W.	C.	S.L.
Means	28.3	33.67	29.23	33.8	41.0	41.17

Note. N.W. = New Reading Words

M.A. = Meaning Assigned reading words

L.C. = Letter Comparison new reading words

F.W. = Familiar Reading Words

C. = Copied familiar reading words

S.L. = Single Letter among pattern masks

A one-way analysis of variance was conducted to establish if there was a main effect of condition of presentation. Each subject was tested on perception of letters in three New Reading Word conditions of presentation and two Familiar

Reading Word conditions of presentation. An Anova of conditions of presentation for both the new and familiar reading vocabulary was performed. According to the one-way analysis of variance, there was a main effect of condition of presentation, $F\ (1,29) = 31.37$, $p<.001$.

Tukey's Test

A Post Hoc comparison (Tukey's Test) of the differences between the means of correctly reported letters showed the significant differences at the .05 level of significance. Table 2 shows the differences in scores for the conditions of New Reading Words. Table 3 shows the differences in scores for the conditions of Familiar Reading Vocabulary. Differences that are significant are marked*.

Table 2
Turkey's Test Comparing Differences Between the Means of Correctly Reported Letters in New Reading Word Conditions

	Conditions			
	M.A.	L.C.	N.W.	S.L.
M.A.	-	14.44*	5.34*	7.50*
L.C.	-	-	.90	11.94*
N.W.	-	-	-	12.84*
S.L.	-	-	-	-

Note. * significant at $p < .05$

M.A. = Meaning Assigned

L.C. = Letter Comparison

N.W. = New Reading Word

S.L. = Single Letter

For the New Reading Words, note that there is a significant difference between the Letter Comparison condition and the Meaning Assigned condition. Also note that the mean score for the Single Letters is significantly higher than the mean scores for the other conditions of the New Reading vocabulary.

Table 3

Tukey's Test Comparing Differences Between the Means of the Correctly Reported Letters for the Familiar Reading Word Conditions

	Conditions		
	C.	F.W.	S.L.
C.	-	7.20*	.17
F.W.	-	-	7.37*
S.L.	-	-	-

Note: *significant at $p < .05$

C. = Copy

F.W. = Familiar Word

S.L. = Single Letter

For the Familiar Reading Words note that the mean Single Letter score is not significantly higher than the mean Copy condition score, although it is significantly higher than the score of the Familiar Words not worked with in the experiment.

Concordance Analysis

The results of the Concordance Analysis are in Table 4 for the New Reading Words and in Table 5 for the Familiar Reading Words. Note that the pattern of the results in the Concordance Indexes are similar to the pattern of the results in the Anova.

Table 4

Concordance Index of the Dependency of Recognizing a Letter in a New Reading Word Dependent Upon Recognizing Another Letter in the Word

	Conditions		
	Meaning Assigned	Letter Comparison	New Word
Mean Concordance Index Scores	.65	.59	.59

Table 5

Concordance Index of the Dependency of Recognizing a Letter in a Familiar Reading Word Dependent Upon Recognizing Another Letter in the Word

	Conditions	
	Copy	Familiar Word
Mean Concordance Index Scores	.81	.66

Analysis of Position

An Analysis of Position showed that in the conditions of new and familiar five letter reading words, the first letter is most recognized, and in all conditions there is a serial effect of one, two, five, and then three and four. See Figure 1. However, the position curves are not the same for the different conditions. Notice that for the New Reading Words, the Meaning Assigned condition of words has the flattest test curve. Note also that the position curve is much less marked for the Copy condition words than for the Familiar Words not worked with in the experiment.

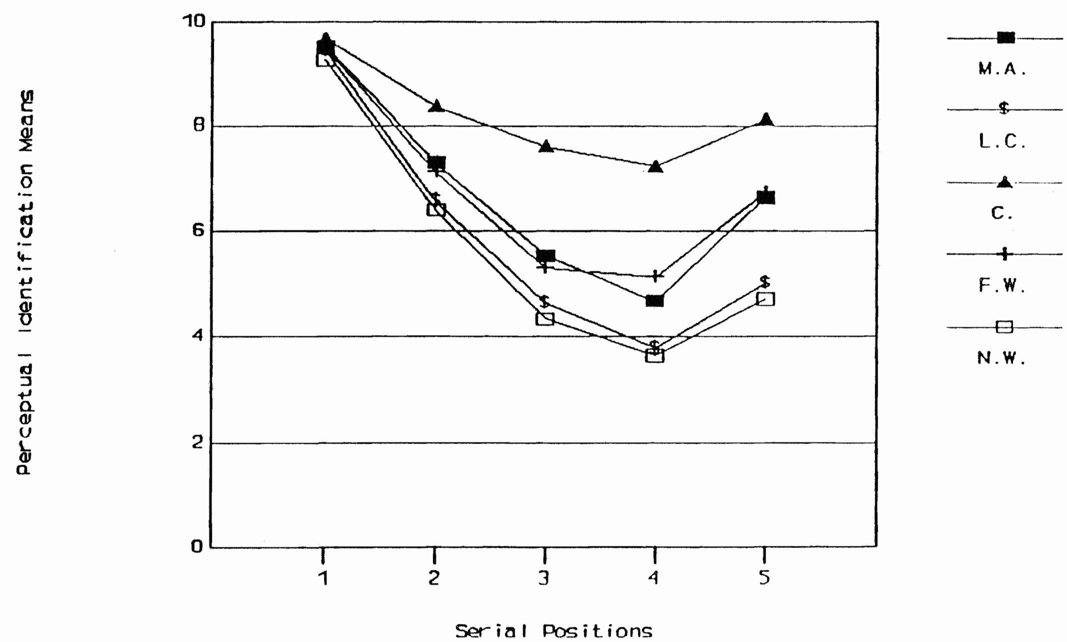

Figure 1. Letter Position Perceptual Identification Means

Point Biserial r^2

The correlation of perception of letters of the words and recall of meaning of the words was not significant (Point Biserial $r^2=.108$, $t(298)=.113$).

Supplementary Data

Reading times. The reading times of words in the different conditions varied greatly. See Tables 6 and 7. As can be seen in Tables 8 and 9, the pattern of fastest reading times showed a pattern similar to the results of perception of letters in words and the Dependency Analysis of letters in words (Concordance Index).

Table 6

Total Reading Times of New Reading Words by 30 Children

	Conditions		
	Meaning Assigned	Letter Comparison	New Words
Time in Seconds	516	652	803.5

Table 7

Total Reading Times of Familiar Reading Words by all 30 Children

	Conditions	
	Copy	Recognized Words
Time in Seconds	290	351

Table 8

Comparison of the Scores of Perceptual Identification of Letters, Integration of Letters, and Speed of Reading for New Reading Vocabulary.

	Conditions						
	S.L.		M.A.		L.C.		N.W.
Perception of Letters	S.L.	>	M.A.	>	L.C	=	N.W.
Concordance Index			M.A.	>	L.C.	=	N.W.
Fastest Reading			M.A.	>	L.C.	>	N.W.

Note. S.L. = Single Letters

M.A. = Meaning Assigned new reading words

L.C. = Letter Comparison new reading words

N.W. = New Reading Words

Table 9

Comparison of the Scores of Perceptual Identification of Letters, Integration of Letters, and Speed of Reading for Familiar Reading Vocabulary

	Conditions				
	S.L.		C.		F.W.
Perception of Letters	S.L.	$\geq$	C.	>	F.W.
Concordance Index			C.	>	F.W.
Fastest Reading			C.	>	F.W.

Note. S.L. = Single Letters

C. = Copy Condition of familiar reading words

F.W. = Familiar Reading Words

Limitations of the exposure of words for the timing of reading. All words in all conditions were exposed to the subjects before testing the speed of reading. For all conditions except the Meaning Assigned condition, the words were exposed orally by having each child read out loud with the examiner, the words in a mixed order. However, the

Meaning Assigned condition words were exposed by having each child attempt to define the Meaning Assigned words presented visually to him or her. This discrepancy between exposure of the words in the Meaning Assigned and the other conditions was because the relationship between a subject's knowledge of meaning and perception of Meaning Assigned words is of great importance in the study, and it, therefore, took precedence over exposing the Meaning Assigned words in the fashion of all other conditions of words.

The testing of the speed of reading words, blocked by condition was, however, consistent for all conditions including the M.A. condition. All subjects read each condition of words, blocked by condition, and the reading of each group of words was timed.

Training times for conditions. After observing that subjects were taking considerably longer to train for the Letter Comparison condition task than for the Meaning Assigned task, a record was kept to compare the training times taken by the last ten subjects. It was discovered that the time taken by the ten subjects at the Letter Comparison task (as seemed to be occurring with the other twenty subjects) was more than twice as long as for the M.A. task.

It is understandable that it could have taken children much longer to perform the Letter Comparison task than the Meaning Assigned task because it was probably a more trying task for the children. However, it might be worth noting that this longer exposure time of the words in the Letter Comparison condition was accompanied by lower letter perception, lower letter integration, and lower speed of reading the words in this condition than for the words in the Meaning Assigned condition.

Findings as they Correspond to the Hypotheses

Hypothesis I. The purpose for which a child encounters new reading words prior to a perceptual test will influence the child's ability to perceive the letters in these words.

This study showed that the manipulation of the purpose for which children encounter real words prior to a perceptual test influences the accuracy of identification of these words. This result supports the findings with adults and pseudowords in the Whittlesea and Cantwell study (1987). Both this study and the Whittlesea and Cantwell study (1987) found that learning for meaning, as opposed to doing a letter-by-letter task, produces the better perceptual learning of new reading vocabulary, and that the task of copying already recognized words improves the perception of these words over other recognized words which are not worked with in this way.

Hypothesis II. The amount of perceptual integration of the letters in new reading words is a function of the tasks employed in acquiring the words.

Integration of the letters in new reading vocabulary words experienced by the children in this study was significantly affected by the demands of the tasks. Unrecognized words showed significant letter integration when trained in a Meaning Assigned task as opposed to a Visual Letter Comparison task. Furthermore, this integration skill paralleled the subjects' superior perception of letters in these words.

Hypothesis III. Copying familiar reading words affects the perception of the letters of these words.

Letters of Recognized Words of the children were perceived significantly better after being copied by the children a total of five times over the course of the training phase of the experiment.

Hypothesis IV. Requiring the copying of words by a child that he or she already recognizes visually, causes greater letter integration in those words.

The Copied words had significantly greater letter integration than did the Familiar Words.

Hypothesis V. The perception of letters in familiar reading words will be superior to the perception of letters in isolation.

For the children, letters scored higher singly than in words, except for letters perceived in the Copy condition (in which the words were already recognized by the children and were then worked with further by copying them). This was contrary to the result for adults in the Whittlesea and Cantwell study (1987).

Chapter Five

Summary and Discussion

Summary

This study demonstrates that for children who are learning to read, the nature of the visual letter codes for a word vary as a function of the contexts in which they are exposed. It was discovered that the learning of new reading words with their definitions and the copying of familiar reading words facilitate letter item learning as well as letter integration in these words. These findings were supported by the less well substantiated results of faster reading items. This is possibly because the Meaning and Copy tasks encouraged integration of the letters in these words in ways which facilitated processing during later word recognition.

Discussion

Theoretical Implications. Many researchers have argued that meaning is important in word recognition (Goodman, 1979; Smith, 1971). However, the advocates of this position have failed to differentiate the effects of meaning at the time of learning from the effects of meaning at the time of recognition.

Furthermore, they have not specified precisely how meaning interacts with phonemic or orthographic information. This study showed that there is no relationship between the knowledge of meanings of words and the perception of the letters in them. Rather, what was observed was that the manipulation of the purpose for which children encounter reading vocabulary words prior to a perceptual test influences the accuracy of identification of these words (i.e., letters were perceived better in M.A. words than in L.C. words). Because it was demonstrated that there was no significant relationship between knowledge of the meanings of words and the correct perception of their letters, it can be argued that it is not the knowledge of a word's meaning per se that results in better letter code learning, nor the fact that each letter in a word is assigned a meaning code, but rather the nature of the processing in which the child engages when learning a word's meaning. Furthermore, it should be kept in mind that this processing enhanced the retrieval of a to-be-learned-word's visual letter codes as individual items and as integrated units independent of what it might have done for the phonemic or semantic codes or for the word as a whole.

Conversely, relatively poor performance occurred in the L.C. condition. This task was designed to get the child to focus on the specific letters of the new stimulus words. Each L.C. word was on the computer screen in front of the subject the entire time that the subject performed the task.

However, proceeding from left to right, each letter was worked with separately by comparing it to a letter in a pseudoword under it. Subjects not only showed poorer letter identification in this condition in comparison to the M.A. condition, but also less between letter integration. In fact, the lack of statistical difference between this condition and the N.W. condition suggests that very little learning may have occurred at all. (There was no significant difference in the perception of letters and integration of letters and although the list reading time for the L.C. condition was less than the N.W. condition, indicating some learning was taking place, the reading time was significantly greater than for the M.A. task).

Superior first letter perception was found in the data of this experiment (see Figure 1). This was probably due to a focusing of the children on individual letters rather than the integration of letters, with the first letter being most noteworthy for children. This is consistent with the findings of Maria Ceprano (1987) who found that beginning readers attend little to the medial parts of words and commented that attempts should be made to help children to attend to these letter positions in an attempt to correct this. It is worthy of note that the first letter perception is most marked in the L.C. and N.W. conditions. By comparing the serial position curves of the N.W. and L.C. conditions (Figure 1), one can see that subjects were relying on initial position letters when encoding both

Letter Comparison words and New Reading Words during the test exposures. It may be that although letter learning was occurring in the L.C. task, the letters were being encoded as separate items and were not being associated with one another nor the lexical representation of the word. This is suggested by both the Concordance Index data and the list reading time results. Perhaps if the test had required the identification of the letters in the L.C. condition as isolated items, performance might have been much better because of the potential overlap between the processing operations employed by the L.C. task and those required at test (Whittlesea and Brooks, 1988).

It was found, also, for children as for adults in the Whittlesea and Cantwell experiment (1987), that copying words already recognized by a subject a total of only five times, results in significantly greater perception of letters in the familiar reading words. It seems that for both adults and children, preexperimentally learned words do not consist of stable abstract schemata which cannot be modified by processing. Rather, what is suggested is that the episodic effects of processing can and do affect word recognition regardless of how well or over-learned a word is. This would not be expected in a schema-based model of word recognition. However, it is consistent with an episodic model of word learning.

It might be argued that once a word is learned, its letter codes become stabilized in schemata which do not change across processing instances (LaBerge and Samuels, 1974). This would suggest that it should be difficult to increase the perception and the integration of letters in fimiliar words. The results of the Copy task, however, indicate that this is not the case. The observance of significant improvements relative to the F.W. condition shows that either the schemas for these words had not been fully stabilized or that the letter code information in familiar words can be altered and improved. It appears that the children in the study still had some room left for improvement. Support for this conclusion can be found in their failure to have higher letter identification scores for words than isolated letters as had the adults in the Whittlesea and Cantwell study (1987). Presumably, the letters in the familiar words were not associated well enough with their lexical codes to benefit from feedback activation (McClelland and Rumelhart, 1981). However, this study indicates that considerable changes can be made in the accessibility and integration of letter code information in words which are already part of the child's reading vocabulary and that this may, in turn, facilitate the recognition of these words. It is worth noting that the size of the effect in this condition was larger than that observed for the M.A. condition. Although a direct comparison cannot be made between these conditions because of the confounding of treatment task with word familiarity, the amount of improvement in the C. words is not what one would expect in the negatively accelerated learning curves normally associated with schema theories (Gibson and Levin, 1975). It is interesting to note the apparent similarity between this task and the L.C. task. In both conditions the child had to process the letters of the stimulus word serially, from left to right, and both tasks required that considerable attention be given to each letter of the stimulus word as a separate component. There was improvement in perception and integration of letters and speed of reading words for the Copied familiar reading words compared to the Familiar Reading Words not copied. There was, however, no significant improvement of perception or integration of letters, and only a small increase in reading speed of the L.C. condition words over the N.W. (M.A. words showed a greater increase than L.C. words over New Reading Words).

It seems likely that in the copying task, the subjects were able to maintain the lexical representations of the stimulus words in working memory while printing them, or groups of letters in them, as a unit. This type of processing may have been facilitated because of the familiarity of the words or because copying does not require decisions which disrupt the maintenance of lexical information in working memory.

<u>Limitations</u>: The procedures used were experimental. It is, therefore, important that teachers be informed to not necessarily teach the strict definitions or copy the words

exactly as was done in this experiment. What the results show is that for the children in this experiment, copying known words or learning meanings of new reading words aided learning of these reading words. The recommendation is not that teachers follow the exact procedures of this study, but that they use the information in this study creatively.

It is important, however, to mention the possibility that slight changes in the procedures of this experiment could affect the results. For example, if the words in the Letter Comparison condition were read by the experimenter during the L.C. task, or if the words were experienced in the context of sentences rather than in isolation, it is possible that the results could be different.

Also, it should be noted that in the experiment, the children were worked with individually. This could have implications for classroom teaching where numbers of children are often taught together.

It should be reiterated, as well, that the subjects were thirty middle class, English-speaking, Grade Three children considered to be average socially, emotionally, and intellectually by their teachers. It is quite possible that another group of subjects, different from this one (i.e., younger or disabled) would have different results.

It would be worthwhile and interesting to repeat this experiment with slight alterations in the procedures and to repeat this experiment with different groups of subjects. The results of these proposed studies to the results of the experiment in this paper could be compared to acquire more information about the learning of reading vocabulary words.

Educational Implications. It appears that activities causing increased integration in words result in better perception of words by children. The task of learning meanings with words is such an activity. The Meaning Assigned task for experiencing words caused greater perception of letters in words, greater integration of letters in words, and it seems, greater speed of reading words by the subjects in this experiment than did a Letter Comparison task for experiencing words.

This information is important for educators of reading instruction and should affect the way reading is taught. Perhaps this information supports Language Experience and Whole Word learning. Language Experience involves writing down by the teacher or student, the student's own words as whole meaningful units. The Whole Word approach presents words as unified items about which the student usually knows the meaning or receives information about the meaning. Therefore, both these methods of teaching new reading vocabulary present the words as integrated units with meaning attached, similar to the Meaning Assigned Condition.

However, even more similar to the Meaning Assigned condition of training new reading vocabulary words would be teaching definitions with the words. The finding that learning word meanings facilitates perceptual identification of individual letters is very interesting. The implication of this finding should be quite important to educators involved in the teaching of reading. It implies that learning the definitions of words with the new reading words significantly advances a child's skill at reading the words. It appears that teaching word meanings prior to reading a passage would not only help a child understand the words in a passage, and consequently better understand the passage, but very likely would significantly increase the child's reading skill. It is very important, however, to stress that the meanings of the Meaning Assinged words were learned while the child looked at each word. They were not learned orally prior to the introduction of each word.

It was discovered in the experiment in this paper that the letters of the words trained in a Letter Comparison task in which letters were worked with one at a time were perceived little better than untrained, unrecognized words. If this segregating approach is used for children's exposure to new reading words, a lack of positive effect, as was found by the segregation of the letters in the Visual Comparison task, could quite likely occur. Crowder wrote that the "idea behind the methods grouped together as phonics methods is to teach the individual letters by the sounds they make - not by their conventional names - and then to induce children to blend these sounds together in new letter combinations" (1982, pp. 201-202). It is conceivable that while properly executed phonics programmes will result in the subject's blending of the sounds of the words, improperly taught, phonics could result in children not induced to bridge the gap between sounding out individual letters and blending. If this segregation of the letters occurs in some instances of attempting to decipher words through letter sounds not blended, some of the inhibiting of learning associated with the Letter Comparison task could possibly occur. It is important that educators realize the probable disadvantages of allowing segregation of items within words if the intention of the teacher is to teach the reading of new reading vocabulary.

It is probably not so much that the Letter Comparison or Meaning Assigned conditions are privileged conditions which hinder or aid the learning of reading vocabulary respectively, but that these conditions of learning are contrary or similar to the conditions of retrieval (Whittlesa and Brooks, 1988). It is important that educators realize the implications of the results of the Meaning Assigned and Letter Comparison conditions. It is probably very important for optimum learning that the learning of a word be consistent with the situations of future use of the word. Therefore, the evidence is that one should not promote the segregation of the letters of words when teaching new reading words if the desired result is the later use by the student of the letters of the words in an integrated fashion such as reading. It could be argued that learning reading by reading will give a perfect match between encoding and decoding. Smith says that children learn to read by reading (1971). This could be the case in certain instances. However, it is difficult for the teacher to know when the match will be acquired. Children can vary their processing strategies when reading and therefore might process the same word differently from one reading experience to the next (Just and Carpenter, 1987). For example, children may read by using context (Stanovich, 1980) which might prove successful if the same sentence context can be reinstated. However, this word learning would probably not be very advantageous for learning the integrated letter unit. Therefore, if the sentence context in the subsequent encounter(s) did not provide enough information for lexical retrieval, the reader might have to try a strategy that required processing letter code information. Consequently, the child would probably be at a disadvantage at this time of re-reading the word.

In this experiment, it was found that copying a familiar word is helpful to increased skill at reading by a child. This could be useful information for the increased learning of known vocabulary words. Perhaps situations could be created in the classroom for a great deal of written use of reading vocabulary words.

It is very worthwhile for educators to know that simply copying a recognized reading word five times increased the perception of the letters, integration of the letters, and speed of reading the word for these children. Creating interesting situations for children to write out recognized reading words a number of times would probably be a very worthwhile challenge for a teacher.

The importance of integrated letter code learning in word recognition indicates that, as Jackson and McClelland (1979) and Rumelhart and McClelland (1981) found, features and letters and the efficient processing of letter codes are indeed important to reading skill. From the research in this paper, it appears that in the initial stages of the learning of reading vocabulary, letter item learning is important and that certain approaches to word learning cause increased perception of individual items within words and of the integration of these items. It appears that both the individual items within each word as well as the complete unit of the word are important in the learning of reading vocabulary, the progression being from item learning to a more integrated learning of the unit, as the reading ability of the student progresses. This was demonstrated in the differences in the children's and adults' perception of letters in isolation and in words in this study and the Whittlesea and Cantwell study (1987). It is important to note from this study that this reading progression can be enhanced and accelerated by simply working with words in particular ways. This facilitation, for children, appears to be through ways that increase the integration of the letter items in the words.

As mentioned, the results of this experiment can be useful as a reference for comparison of the reading and integration abilities of other types of students. As mentioned earlier in this paper, it would be particularly worthwhile to do this same study with below grade level readers in order to compare their results to those of more average readers. The comparison of the perception and integration results of average children to those of poor readers might be useful for the development of measures of letter code acquisition in words as could further comparison of the average children to the university adults in the Whittlesea and Cantwell study (1987). It would also be interesting to do an experiment to find the effect of the Copy task on Grade Three children learning new reading vocabulary words and to find the effect of the Meaning Assigned and Letter Comparison tasks on recognized reading words.

The evidence is that children are probably at a less integrated stage of learning words and of word recognition since, for the children, single letter scores were higher than letter scores in words, and adults had the opposite result (Whittlesea and Cantwell, 1987). Also, the evidence is that experiencing reading vocabulary words in an integrated fashion appears to cause greater integration and perception than experiencing the letters in a segregated fashion. This study provides important information for educators about increasing reading skill for children, and perhaps for adults as well, since greater integration and perception results were easily acquired in this present study. It appears that certain conditions seem to drive up item learning and integration. This occurred, in this study, by simply requiring primary children to work in context with reading words a total of only five times in easy tasks which encourage integrated experiencing of the words. These simple tasks resulted in significant increases in letter integration, letter perception, and, it seems, speed of reading the words.

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APPENDIX

Master List of Words from which Words for the Conditions of the Experiment were Acquired.

All are five letters and concrete. Odd numbered words are assessed as being the more simply spelled words and even numbered words the more complexly spelled words.

1	badge	25	cider	49	human
2	beige	26	aisle	50	dough
3	bathe	27	label	51	boost
4	canoe	28	niece	52	pearl
5	cupid	29	comma	53	jewel
6	cocoa	30	broil	54	field
7	bugle	31	coral	55	lilac
8	cycle	32	build	56	gouge
9	bulge	33	cubic	57	miner
10	hyena	34	chaos	58	joint
11	burnt	35	arena	59	entry
12	lysol	36	chief	60	kneel
13	burst	37	curve	61	paste
14	mauve	38	choir	62	knock
15	cable	39	demon	63	rapid
16	moist	40	cloud	64	neigh
17	canal	41	atlas	65	razor
18	pause	42	couch	66	odour
19	cedar	43	bagel	67	rifle
20	scene	44	cough	68	ounce
21	chime	45	fever	69	sewer
22	seize	46	doily	70	pouch
23	cigar	47	focus	71	siren
24	style	48	nylon	72	rough

73	virus	107	acorn	141	awake
74	screw	108	croak	142	weigh
75	braid	109	guide	143	begin
76	shawl	110	scout	144	voice
77	alien	111	adult	145	basin
78	snout	112	blood	146	argue
79	angle	113	belly	147	crust
80	swear	114	eight	148	crumb
81	carve	115	usher	149	black
82	sweat	116	earth	150	bread
83	bully	117	baton	151	brown
84	sword	118	olive	152	climb
85	chirp	119	batch	153	bench
86	wound	120	ocean	154	green
87	depth	121	beefy	155	blast
88	wreck	122	alley	156	count
89	dairy	123	gravy	157	clock
90	yacht	124	catch	158	-
91	dwarf	125	bible	159	class
92	plaid	126	right	160	-
93	giant	127	cabin	161	blush
94	poach	128	sight	162	-
95	graph	129	shout	163	chair
96	pound	130	wharf	164	-
97	plier	131	woman	165	cheek
98	suede	132	yield	166	-
99	onion	133	pedal	167	crack
100	thigh	134	write	168	-
101	erase	135	seven	169	clean
102	touch	136	calve	170	-
103	groom	137	white	171	brick
104	weave	138	wrist	172	-
105	pecan	139	video	173	bride
106	drown	140	witch		